Space Weather Technical Forecast

Issued on Wednesday 19 March 2025 at 13:11 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. Chance G1-G2/Minor-Moderate Storms Days 1-3 (19-21 Mar) due to CME arrivals.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with only C-class flares observed in the past 24 hours. There are currently ten sunspot regions on the visible disc. AR4028 and AR4031 are the two largest and more magnetically complex regions on the disc. Both have seen some growth of trailer and intermediate spots. None of the remaining spots are showing any significant magnetic complexity, are relatively small, and appear to be stable.

A filament eruption from the north-centre disc was observed around 19/0034 UTC, with analysis awaited as to whether there is any Earth-directed component from any subsequent CME.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, were at background to slightly elevated levels, ranging between 390-480 km/s. Density was below average. Interplanetary Magnetic Field, Bt, was weak to moderate, peaking at +12nT, with the north-south component, Bz, weak to moderate, ranging between +6 and -11nT, favouring a negative orientation. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp2-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was initially High, peaking at 3090pfu at 18/1330 UTC, before falling to background overnight. The 24-hour fluence was above the Active (1e8 integrated pfu) at first, before dropping back to below the Active threshold, on a slow declining trend. The observed integrated pfu was 4.03e7 at 19/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are three CMEs which feature in the forecast in the coming days (19-21 Mar). Solar winds are likely to remain mostly at slow to slightly elevated levels, with elevated enhancements possible due to forecast CME arrivals. Quiet to Unsettled activity

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expected initially, with a chance of G1-G2/Minor-Moderate storms Days 1-3 (19-21 Mar) should any of the three possible CMEs arrive and/or combine.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at background to moderate levels. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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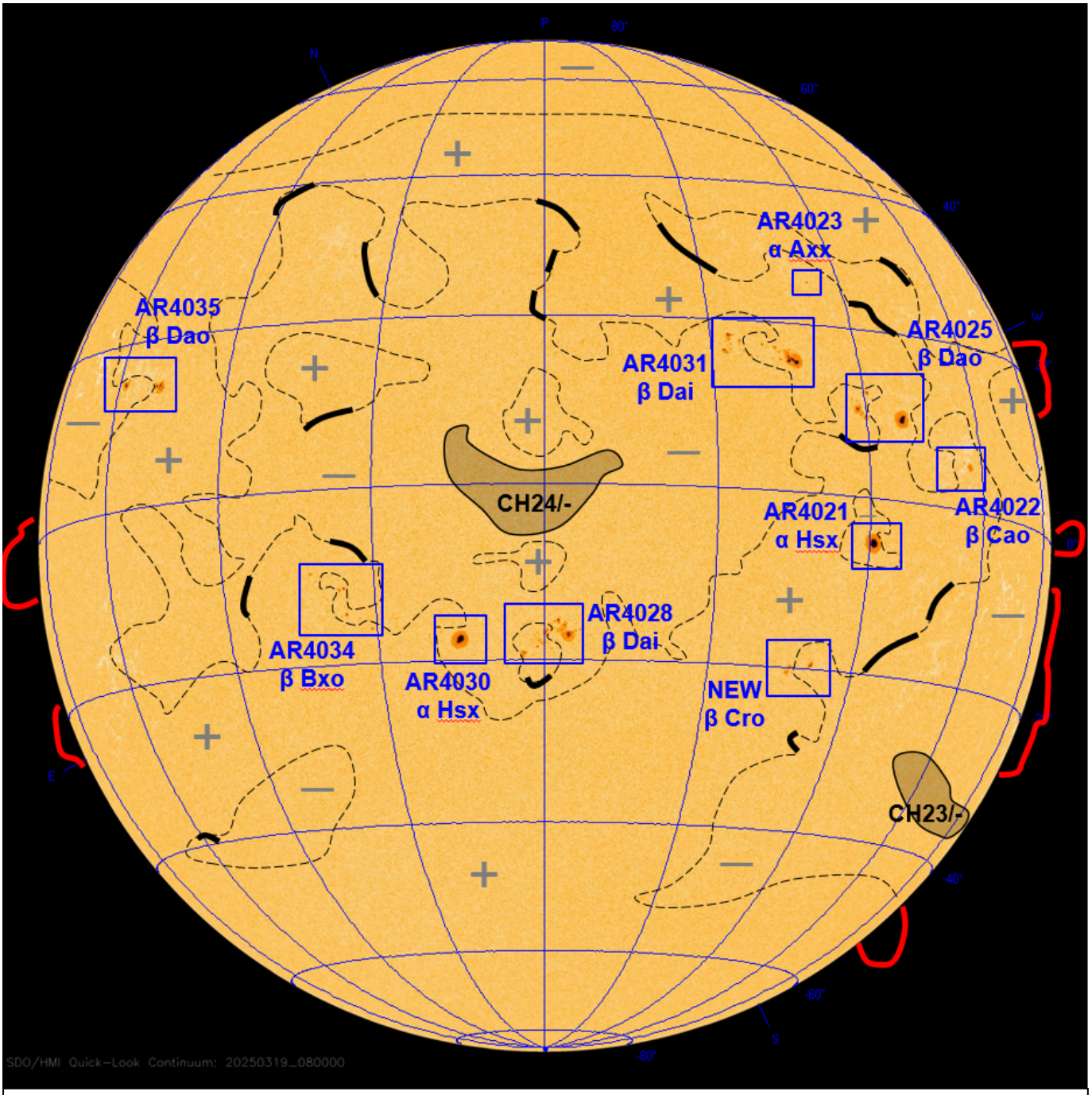
Figure 1: Solar Synoptic Map valid 19/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME was observed to the NE, possibly as a result of a filament eruption from the north-centre disc that occurred around 19/0034 UTC, with analysis awaited as to whether there is any Earth-directed component.

There are three CMEs which feature in the forecast, the first from a filament eruption which occurred in the northeast quadrant, within the vicinity of CH24/-, at 16/2020 UTC. This produced a partial halo CME in coronagraph imagery, with an associated shock evident. Analysis suggest a glancing blow arriving at Earth either late on Day 1 (19 Mar) or early on Day 2 (20 Mar). Given the filament was near CH24/-, there may have been some deflection towards the south and west, which is currently under consideration. EPAM observations showed a rise in low energy protons around 19/0900 UTC, possibly signalling a slightly earlier arrival than originally forecast.

The second CME was from a filament eruption in the northwest around 17/1030 UTC, just ahead of AR4025 with ejecta clearly leaving to the west, though a faint halo can be seen later on Stereo-A imagery. This CME forecast for late Day 2. The third CME was associated with the 17/1930UTC M1.0 flare and filament eruption from a region of plage in the northeast. This CME mostly travelled north, but once again may have an Earth-directed component, perhaps arriving early on Day 3 (21 Mar).

Otherwise, no significant coronal hole enhancements are expected in the period, with solar winds currently slightly elevated.

Confidence in the geomagnetic forecast is low due to the number of possible CMEs, and the possibility one or more may combine together in transit, or even miss Earth all together. Quiet to Unsettled activity is expected initially, with a chance of G1-G2/Minor-Moderate storms Days 1-3 (19-21 Mar) should any of three possible CMEs arrive and/or combine.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	40	30	30	5
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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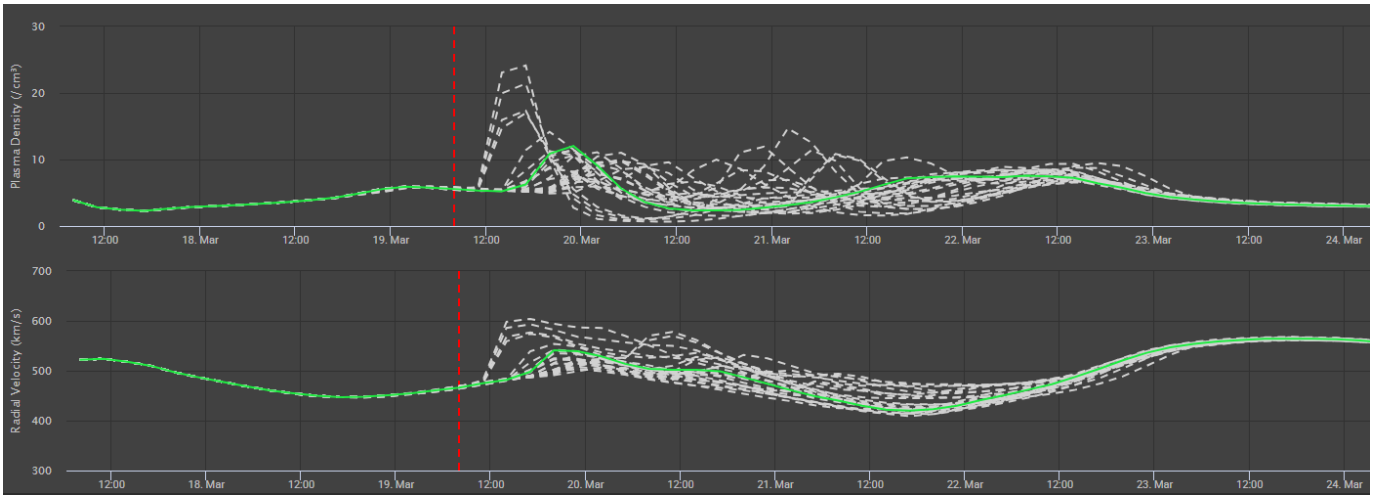
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
17/0253	Partial	Filament Eruption	Northeast	580	19/2100	A large shock associated with this CME.
17/1809	Partial	Filament Eruption	Northwest	600	20/1800	Low confidence on exact timing due to interactions with other CMEs. May combine.
18/0215	Partial	Filament Eruption	Northeast	520	21/0100	Low confidence. Chance of a glance.

Figure 2: MOSWOC Ensemble model showing spread of possible CME arrivals through the forecast period.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low, with only C-class flares observed in the past 24 hours.

There are currently ten sunspot regions on the visible disc. AR4028 and AR4031 are the two largest and more magnetically complex regions on the disc. Both have seen some growth of trailer and intermediate spots. AR4035 continues to rotate onto the disc in the northeast, although its proximity to the limb makes it difficult to get a detailed analysis. However, this region has continued to show development of penumbra on both its leader and trailer spots. None of the remaining spots are showing any significant magnetic complexity, are relatively small, and appear to be stable.

Low to Moderate activity is expected, with a chance of isolated M-class flares.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	No	40	40	40	40
Very Active	**R3-R5 (X Class)**	No	5	5	5	5

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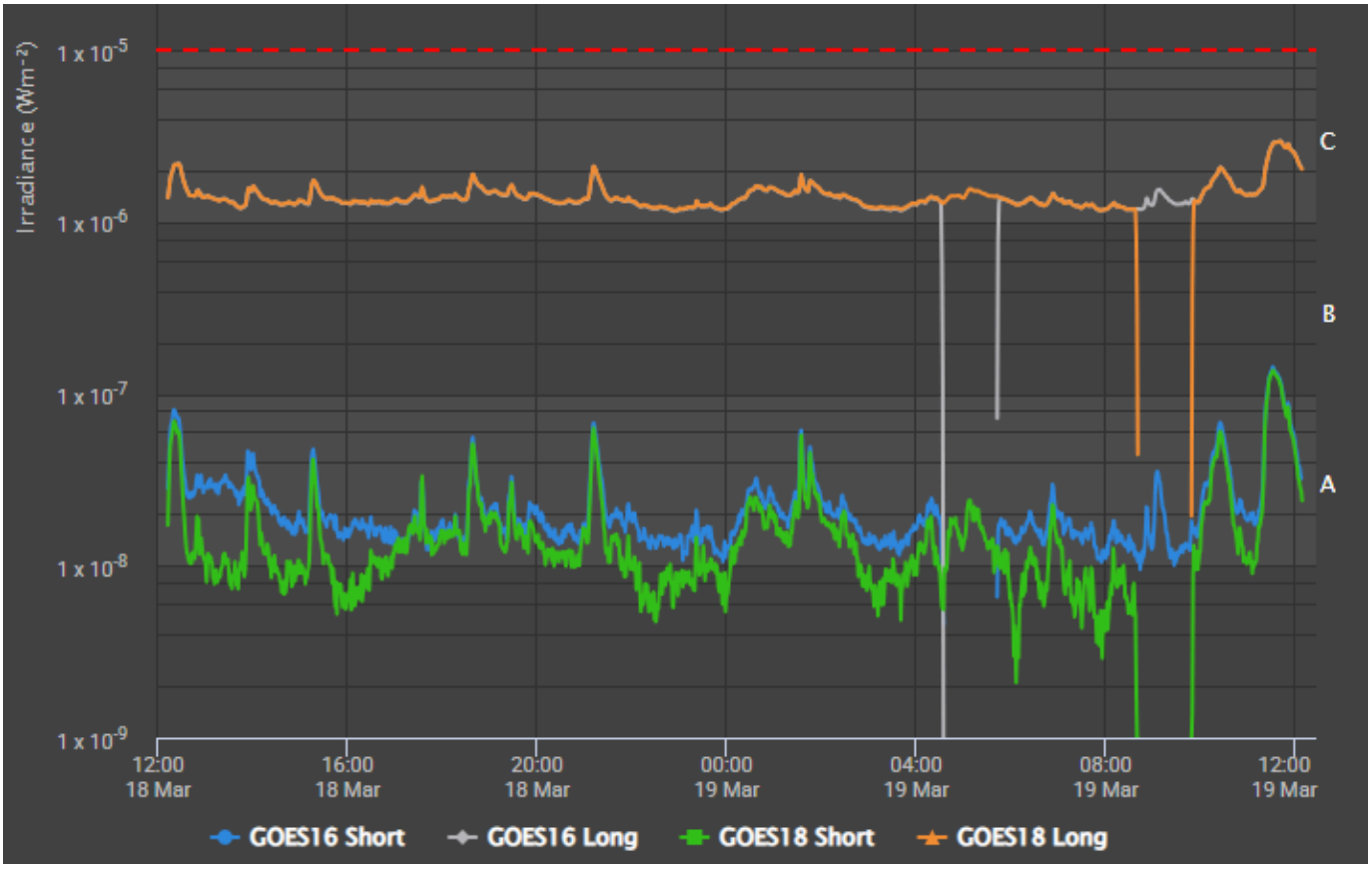
Figure 3: GOES-16 & -18 X-ray flux.



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current inactivity and magnetic simplicity of the small regions on the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux has fallen from diurnally high levels over recent days down close to background. With possible CME arrivals expected over the next few days (19-21 Mar), this may serve to clear some electrons from their orbits, keeping flux at background to moderate levels, although prior to, or in the absence of, any CME arrivals electron flux could return to high levels. Confidence is therefore low due to these uncertainties in the CME forecast.

The associated 24 hour fluence has recently returned to below threshold levels, on a slow declining trend. MOSWOC REFM shows the fluence should remain below the Active threshold throughout the remainder of the period, especially with possible CMEs arrivals in the coming days, and is considered reasonable guidance, albeit with low confidence.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	Yes	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES-16 Electron flux

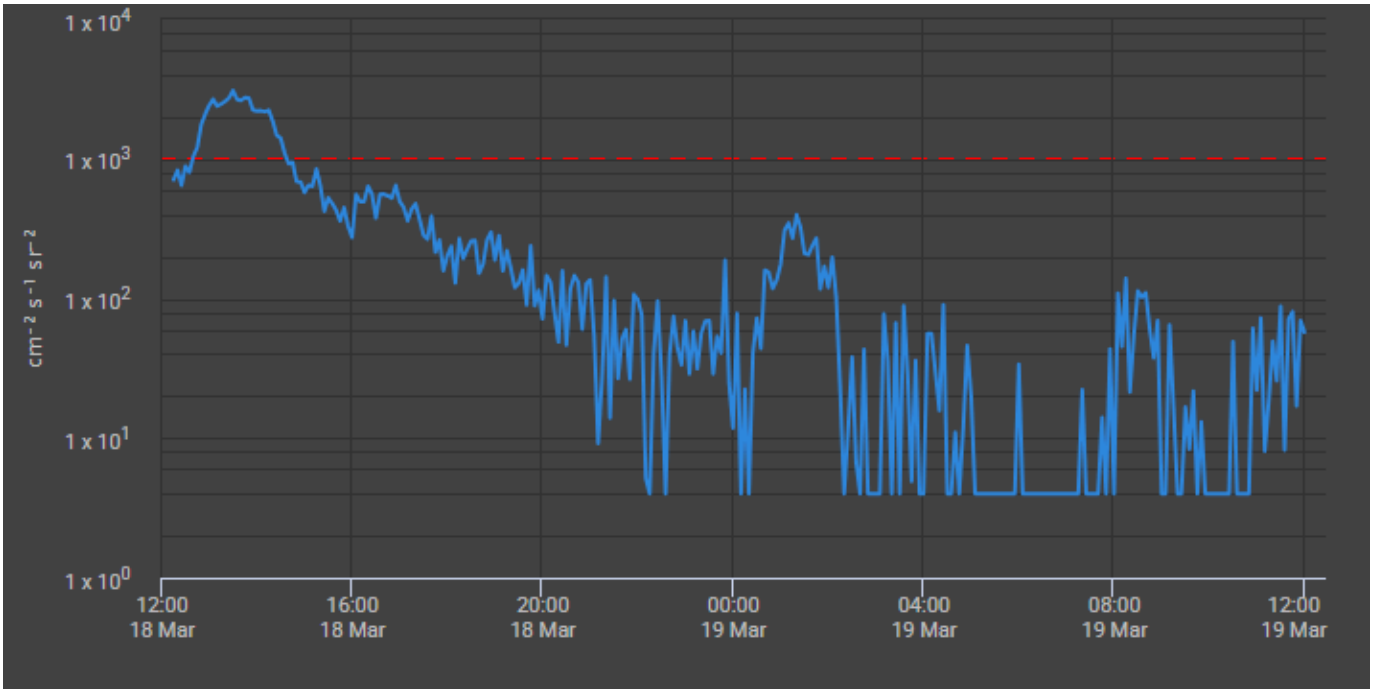

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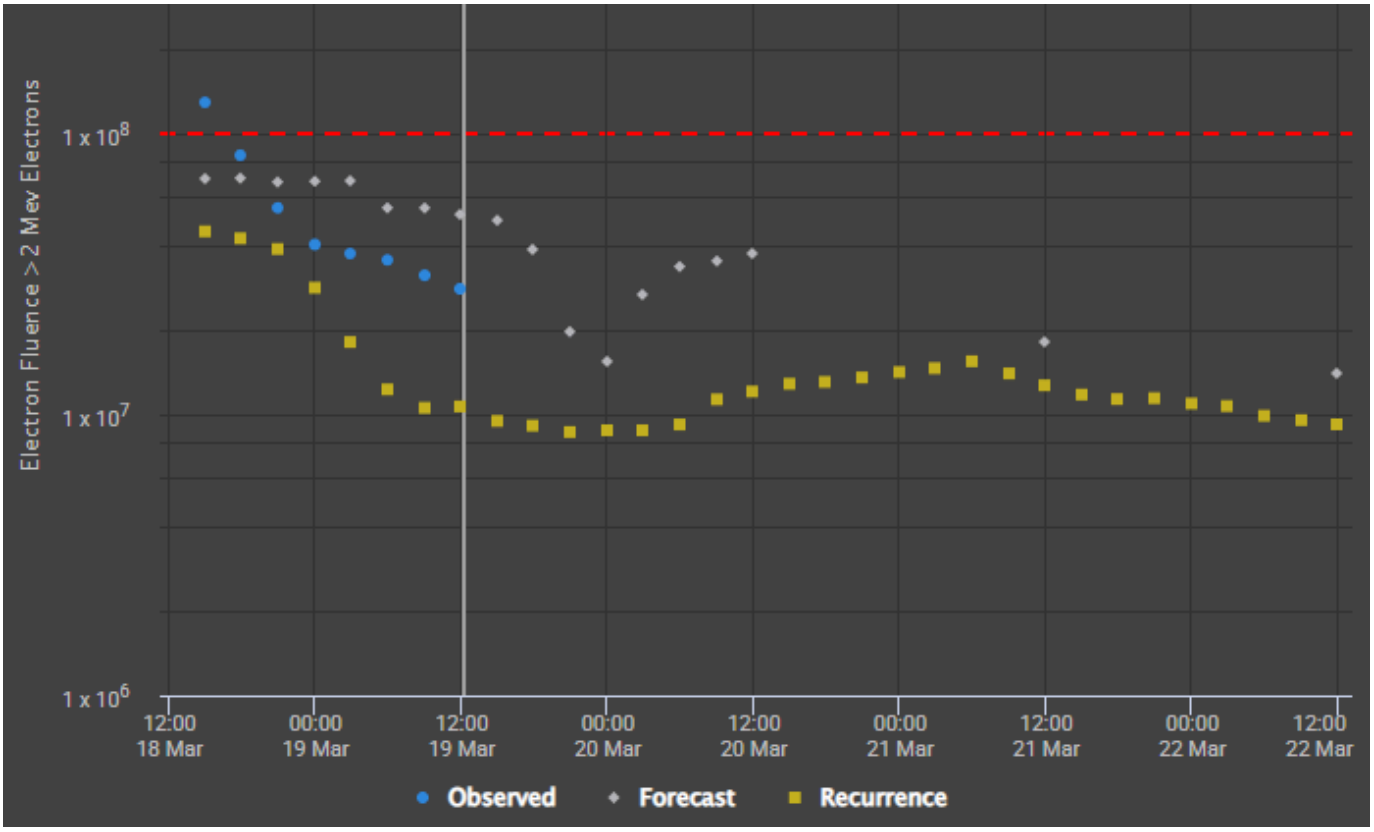
Figure 5: MOSWOC REFM



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